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RAPTOR RESEARCH is published quarterly in Spring, Summer, Fall, and Winter issues and occasional Supplements. The contents are usually divided into three sections. The first section is *SCIENTIFIC PAPERS* for reports of original research or theoretical analyses. These papers will be given careful editorial and referee scrutiny. A second section, *REPORTS, REVIEWS, AND OPINION,* will include secondary material, translations of material originally published elsewhere, reports of work still in progress, reports on meetings, often in some detail, book reviews, and other similar items. This material will be edited for accuracy but will not receive the critical review given the Scientific Papers. Because of the preliminary or secondary nature of the material in this section the Editors recommend that this material be cited in other papers only with great care or in a very general way and especially with specific preliminary or conference material only after consultation with the source of that information. Papers which express a personal opinion or letters to the Editor will be included in this section. *NOTES, NEWS, AND QUERIES* is used for notices of information or events, requests for information, news items either specially prepared or reprinted from other sources, and similar small items.

This journal began publication as RAPTOR RESEARCH NEWS with Volume 1 in 1967 as a quarterly in typewritten mimeographed form on an 8½" by 11" page size. Volumes 2 and 3 in 1968 and 1969 were offset printed but continued the same frequency, page size, and standard typewriter type. An analytical index for Volumes 1-3 was published. Volumes 4 and 5 in 1970 and 1971 were published six times a year in offset printing, 5½" by 8½" page size, and with IBM Composer typefaces; an analytical index for Volumes 4-5 is in preparation. In 1972, Volume 6, the name of the journal was changed to reflect the broader scope to RAPTOR RESEARCH. Currently the journal is published quarterly by offset printing with 6¾" by 9½" page size and IBM Composer typefaces and annual analytical indexes.

For membership and publication costs see inside back cover.

CURRENT WORK ON RAPTOR DISEASES IN KENYA, EAST AFRICA*

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Introduction

Kenya, like the other East African countries, is rich in birds of prey and its indigenous species are supplemented by migratory species from Europe and Asia. Some research has been carried out into the ecology of these birds, notably by Brown (see for example, Brown 1970) but a vast amount of work remains to be done.

Despite their large numbers in the wild, few birds of prey are maintained in captivity in Kenya. There are small numbers in private hands, kept mainly as pets or for exhibition, but no large zoological collections. As far as falconry is concerned, this is unknown amongst the indigenous Kenyan population although there is archaeological evidence (an old hawk bell excavated at Gedi) that Arabs visiting the East African Coast centuries ago might have brought their hawks with them: it appears however that the sport never spread. Amongst the expatriate population of Kenya there are, perhaps, six falconers but of these only two are, at the time of writing, flying a bird.

The author has been engaged on a study of raptor diseases since 1965 and when he came to Kenya in 1969 this work was continued. As far as is known, there had been no previous research on diseases of East African birds of prey and it was therefore an ideal opportunity to contribute some veterinary knowledge to the expanding data on these species. Such work seemed justified for the following reasons: (a) there is increasing concern over the future of East Africa's wildlife and while the larger mammals receive considerable attention, there has been little research on the avian fauna, including raptors; (b) although captive birds of prey are of little significance in Kenya *per se,* work on them and their wild counterparts could well help provide information of importance to those flying or breeding raptors in Europe or America. The relative abundance of raptors in Kenya makes it easier to obtain specimens for such research.

In this paper the author outlines his work over the past three years on raptor disease and emphasizes how important a role the veterinary surgeon can play, in

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March, 1973.

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conjunction with scientists or other disciplines, in furthering our understanding of the biology of these birds.

Projects

The following work has been, or is, in progress:

(1) Routine clinical and *post-mortem* examination of raptors.

(2) Work on a small collection of captive raptors, with special attention to normal hematological values and vaccination procedures.

(3) Investigation into new anesthetic techniques, particularly with regard to the taking of biopsies for pesticide analysis.

(4) Joint research with other, non-veterinary, colleagues working on raptor biology.

Each of these aspects will be considered in turn.

(1) **Clinical and post-mortem work.** Material has been received mainly from the public but also from National Parks and the Game Department; it has included both wild and captive birds. Even road casualties are accepted and such specimens have frequently yielded valuable tissues for histological section or interesting endo- or ecto-parasites.

Lists of clinical and *post-mortem* cases have been submitted annually to the Chairman of the Raptor Research Pathology Committee but a summary of the situation from 1970 to date is as follows:

Number of clinical cases examined–42.

Number of *post-mortem* examinations carried out–37.

Several interesting diagnoses have been made, amongst them a dual infection of an African Fish Eagle (*Haliaeetus vocifer*) with an *Aspergillus* sp. and acid-fast organisms (Kaliner and Cooper 1973), bumblefoot in a Tawny Eagle (*Aquila rapax*) and a large number of cases of traumatic injury. A certain amount of surgical and medical treatment has been possible. At the time of writing, an investigation is in progress into a severe epizootic of sinusitis in a private bird collection which has already killed seven birds of prey of two different species.

(2) **Work with a private raptor collection.** Although some considerable success has been achieved in the treatment of sick raptors, a percentage are, inevitably, unable to be released or returned to their owners and have to be retained in captivity with the author.

Although this collection has never exceeded a total of 20 birds, a number of species are usually represented and this has permitted a degree of experimental work that would not be possible at the author's home in Britain. The following work has, in particular, been carried out.

(a) *Hematological studies.* There is very little information on the hematology of raptors despite evidence from the poultry field (Bierer *et al.* 1968) that such data could be of value in the diagnosis of disease. With this in mind a small survey is in progress and although to date only PCV (hematocrit), red blood cell counts and hemoglobin estimations are carried out, further tests will be attempt-

ed in the future. An initial report on this work has appeared in *Raptor Research* (Cooper 1972). Preliminary results suggest that more use could be made of hematology in the examination of sick raptors, especially to aid the prognosis in cases which are anemic or dehydrated.

(b) *Vaccine trials.* The author has vaccinated his captive birds with inactivated Newcastle disease vaccine and a live (attenuated) fowlpox vaccine. In the case of the former, serological studies (hemagglutination inhibition tests) have been carried out in order to assess the response, if any, to the vaccine. Preliminary results suggest that raptors do not respond so well serologically to the vaccine as do domestic poultry and that the antibody titre attained quickly drops. In the case of the pox vaccine (given by the wing stab route) no serological studies have been attempted but the vaccine is certainly not associated with any adverse side effects in raptors, even if up to 25 times the recommended dose is administered. This work continues and it is hoped that the results will prove useful to those who maintain birds of prey in captivity.

(c) *Harrier Hawk work.* A particular study has been carried out on a captive pair of African Harrier Hawks (*Polyboroides typus*) including studies on their feeding behavior and moult. Of special interest is the ability of this species to overextend the tibiotarsal joint and x-ray and other studies of this are in progress. These birds are anesthetized monthly and full data recorded. Now that they are mature it is hoped that they might breed in captivity though their very nervous nature makes this unlikely.

(3) **Anesthetic techniques.** When the author first came to Kenya he had already carried out preliminary trials in England on the new avian anesthetic, metomidate ("Hypnodil": Janssen Pharmaceutica). Further work in Kenya emphasized the value of this drug, by the intramuscular route, in work on birds of prey. A preliminary paper on its use has been published (Cooper 1970) as has a second which draws attention to the smaller dosage needed in vultures (Houston and Cooper 1973).

In 1971 the author was approached to cooperate with the Baharini Wildlife Sanctuary (Nakuru, Kenya) in work on pesticide residues in Kenyan birds of prey. Such a study had not previously been attempted and seemed an extremely worthwhile venture especially in view of the large quantities of chlorinated hydrocarbon insecticide used in Kenya for tick and tsetse fly control. The study was carried out in conjunction with L. Frank, with later assistance from R. Jackson. The author's role was primarily concerned with suitable techniques for obtaining samples from live raptors. Initially fat samples were taken from the tail region but for the majority of the specimens pectoral muscle biopsies were performed, as described by Seidensticker (1970). Metomidate was found to be unsuitable for such work for a number of reasons (not least of all the delayed recovery and excessive salivation that occurred) and as a result investigations were carried out into the use of the new short acting steroid anesthetic CT1341 ("Saffan": Glaxo Laboratories Ltd.). This drug proved to be extremely valuable, by the intravenous route, for the taking of pectoral muscle biopsies and a paper

on this work has been published (Cooper and Frank 1973). It would be pertinent to mention that the anesthetic has now been used on over 50 occasions in both captive and freshly caught birds of prey and there has been only one mortality, a captive Lizard Buzzard (*Kaupifalco monogrammicus*).

(4) **Joint Research.** A small number of non-veterinarians work on wild raptors in Kenya and close contact has been maintained with them wherever possible. Particular projects have been as follows:

(a) Cooperation with D. C. Houston (formerly of the Serengeti Research Project) in his work on vultures. The author's role here included investigation into the use of metomidate in vultures and examination of parasites and *post-mortem* material. An interesting discovery was the presence of lesions associated with botfly (*Gasterophilus pecorum*) larvae in the crops of a number of vultures and this has been reported elsewhere (Cooper and Houston 1972). Work is at present in progress on the digestive tract of the Whiteback Griffon Vulture (*Gyps africanus*) and the possible role of vultures in the spread of disease.

(b) Work with C. Smeenk (formerly of the Tsavo Research Project) on the birds of prey of Tsavo East National Park. The author's contribution here has been small but some *post-mortem* examinations have been performed, blood samples taken from a number of species and hematological and parasitological investigations carried out.

(c) Joint work with L. Frank and R. Jackson on pesticide residues in raptors (see above). Material from this survey is being analyzed in the United States.

(d) Work on a captive pair of Harrier Hawks (*Polyboroides typus*) (see earlier notes). L. H. Brown has shown particular interest in this study and offers valuable assistance and advice.

Conclusions

It has not been possible, in a paper of this length, to give more than a very brief outline of the author's current work on raptor diseases in Kenya. Nevertheless, it is hoped that the information given will prove of interest to others working in this field and may, perhaps, stimulate an exchange of information. It should be stressed again that much remains to be learned of the biology of the East African raptors (the nest and eggs of some species are still unknown) and the veterinarian has a role to play in such work. In many countries the birds of prey are known to be valuable indicators of changes in the ecosystem and it is reasonable to assume that this may also be the case in East Africa. Studies on the causes of mortality of East African raptors are long overdue and it is in this field that the veterinarian can fill a valuable niche. A word of caution should perhaps be sounded here. The author's study of raptors is largely an extra-curricular one, though he has the backing of a veterinary laboratory and a number of interested colleagues. Although raptor material is available in abundance in Kenya, opportunities for full-time study of birds of prey here are limited. As with all developing countries, Kenya's priorities are to improve the standard of living of her people; as a result the veterinarian is very likely to find himself involved in domestic animal disease with his raptor interests only a sideline. In a

recent paper Roth (1972) outlines the need for more work on wildlife disease in Africa and although he too concentrates on mammals, the points he makes are equally applicable to avian work. Roth only touches briefly on the reticence shown by some African governments to wildlife research and it would be prudent to mention this here. Such reticence stems partly from the shortage of funds which are available in developing countries and partly from ignorance of the importance of wildlife research, but can also be attributed to a certain reluctance to learn too much about wildlife disease for fear of the possible consequences to the domestic livestock industry. An example here is the monitoring of wildlife for chlorinated hydrocarbon insecticide residues, a field of research which may be avoided or delayed if there is fear that the results may adversely affect such economically important ventures as food exports. Notwithstanding these points, it is hoped that, as Kenya and other African countries develop and wildlife studies become more acceptable, work on raptors will assume an increasingly important role.

Acknowledgments

I am grateful to the colleagues with whom the studies above are conducted for their interest and cooperation, to my wife for her constant support and to Dr. D. L. Graham for agreeing to read this paper at the 1973 Conference on Raptor Conservation Techniques.

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RAPTOR REHABILITATION AT THE ALEXANDER LINDSAY JUNIOR MUSEUM*

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ABSTRACT. From 1966 to 1973, 365 raptors have been in the Raptor Rehabilitation and Release Program at the Alexander Lindsay Junior Museum. A total of 171 have been released and 55 are in training for eventual release. Twenty-five species of raptors have been in the program including the endangered Peregrine Falcon (*Falco peregrinus tundrius*) and four non-native species. Details on rehabilitation techniques are discussed.

Introduction

Rehabilitation and release of raptors from the Alexander Lindsay Junior Museum in Walnut Creek, Contra Costa County, California, began in 1966. At the time little was known about medical treatment and rehabilitation of injured and orphaned raptors prior to their release. By 1973, 171 raptors had been released; many initially received broken bones or severe wounds. Several other zoos have begun similar programs, including the San Francisco Zoo. A number of private individuals have released birds, most notably Morlan Nelson of Idaho. The reason for such interest in injured raptors is that many raptor populations are declining in numbers. Therefore, any birds successfully released back to the wild will help slow this decline. Hopefully, this paper outlining our methods of rehabilitation of raptors will stimulate a stronger program for preserving birds of prey than exists at present.

The Museum

The Alexander Lindsay Junior Museum is operated by the Leisure Services Department of the City of Walnut Creek. Its charge is to provide a natural history experience for the people of the community. Part of this experience includes displays of live animals, including predatory birds. Perhaps this accounts for the first injured raptors received in 1966. In any event, the public became aware of the Museum's wildlife rehabilitation potential. By 1973, 365 injured or orphaned raptors had been turned over to the Museum (Figure 1) plus just about every species of animal indigenous to the Walnut Creek area (Table 1).

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March, 1973.

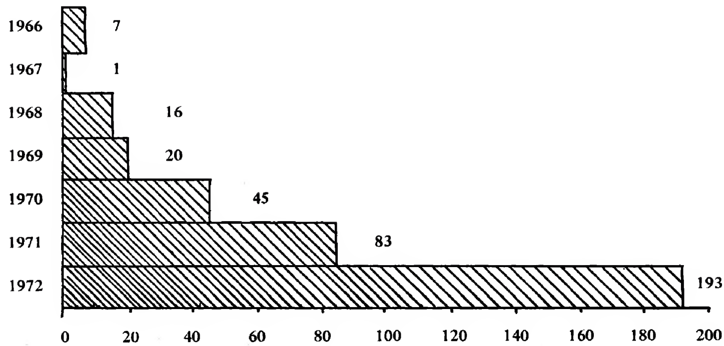

Figure 1. Yearly raptor totals, totaling 365.

The museum staff caring for raptors consists of three salaried staff, a curator and two assistants, and five volunteer trainers. Of the 365 raptors received, 81 percent were brought in by the public. Officials of the California Department of Fish and Game and the U. S. Bureau of Sport Fisheries and Wildlife brought in the other 19 percent. Eighty-five percent of the birds were found within a 15 mile (24 km) radius of the Museum. This figure is significant because, if representative, it suggests that many birds in need of help are lost in similar areas throughout California and perhaps North America. If so, the potential for rehabilitation and releasing injured raptors as a means of halting the decrease in raptor populations has scarcely been touched.

Species Survey

Twenty-five species of raptors have been treated in our program, including four non-native species. Representatives of 13 species have been released (see Table 2). Expired birds include those that died after receipt and those dead prior to receipt. Only birds irreparably damaged and obviously dying are euthanized. Birds incapable of being released due to the loss of a wing or leg are held for placement in zoos or in breeding projects approved by legal authorities.

Table 1. Totals for vertebrate rehabilitation program, 1966 to 1973.

Reptiles	1224	Game birds	291
Passerines	1112	Amphibians	226
Mammals	566	Fishes	162
		Total	4338

Table 2. Total for raptor rehabilitation and release at the Alexander Lindsay Junior Museum, 1966-1973.

	Total	Released	Expired	Euthenized	In training*	Returned to owner	Injured or broken wing	Shot	Car	Stunned or concussion**
American Kestrel	83	58	10	5	9	1	11	3	6	1
Barn Owl	74	42	18	7	7	0	15	3	8	0
Red-tailed Hawk	56	25	8	5	15	3	17	10	1	0
Screech Owl	42	13	23	4	0	2	3	1	8	7
Great Horned Owl	41	16	15	6	4	0	9	4	6	0
Cooper's Hawk	10	1	8	0	0	1	0	0	1	4
Burrowing Owl	9	5	2	0	2	0	2	1	2	1
Golden Eagle	6	3	2	0	1	0	0	0	1	0
Peregrine Falcon	5	0	1	0	3	1	0	0	0	0
Sharp-shinned Hawk	4	0	4	0	0	0	2	1	1	1
White-tailed Kite	4	0	3	0	1	0	1	2	0	0
Short-eared Owl	4	1	0	1	2	0	1	1	0	0
Turkey Vulture	4	3	1	0	0	0	0	1	1	0
Marsh Hawk	3	2	1	0	0	0	1	0	0	0
Long Eared Owl	3	1	2	0	0	0	1	0	0	0
†Crested Serpent Eagle	3	0	1	0	2	0	0	0	0	0
Rough-legged Hawk	2	1	0	0	1	0	0	2	0	0
Red-shouldered Hawk	2	0	1	0	1	0	1	1	1	0
Harris's Hawk	2	0	0	0	2	0	0	0	0	0
Saw Whet Owl	2	0	1	0	1	0	1	0	1	0
Prairie Falcon	2	0	0	0	1	1	0	0	0	0
†Lugger Falcon	1	0	1	0	0	0	0	0	0	0
†Saker Falcon	1	0	0	0	1	0	0	0	0	0
Spotted Owl	1	0	0	0	1	0	0	0	1	0
Goshawk	1	0	0	0	1	0	0	0	0	0
Total	365	171	102	28	55	9	65	30	38	14
Percent		47	28	8	15	2	18	8	10	4

*Also includes birds being held for the California Department of Fish and Game, and birds on display at the Museum.

**Usually a bird flying into a window.

†Non-native species.

Nine birds were returned to their owners. These were falconers' birds that had either escaped or were lost while chasing quarry. Their owners were contacted, and the birds returned. Birds in training include those recovering from injuries, those being trained, those irreparably maimed and incapable of release, and seven confiscated birds being held for the California Department of Fish and Game pending court action.

Injuries Survey

The majority of injuries were man caused, including collisions with cars, windows, and gunshot wounds. Each causes varying degrees of injury. For example, most of the birds shot also had broken wings. Not listed in the injuries survey were six cases of rickets and four cases of blindness, both generally found in young owls. Rickets were caused by improper diets fed by aspiring human parents. If brought in soon enough, these birds can recover when fed a natural diet of rodents. Most, however, were not brought in soon enough. So far, we have been unable to account for the blindness cases.

Medical Care

When an injured bird is brought to the Museum, it is checked for serious injuries such as broken bones and wounds. Each bird is then fed if malnourished, given water by gavage (tubing) to counteract dehydration, and placed in a dark box for several hours to recover from the stress of being handled. Starving birds are fed small amounts of easily digestible food such as baby rats or day-old chicks so as not to tax their strength. Small amounts are fed every few hours until their condition improves. Birds with severe injuries are then taken for veterinary care. Those with simple injuries are cared for by the Museum staff, but all birds are eventually taken to the veterinarian. Our veterinary care is provided by Valley Veterinary Hospital in Walnut Creek. Each bird is given a physical examination and is x-rayed as standard procedure. Fecal samples from all birds are checked for parasites. X-rays reveal broken bones, the location of shotgun pellets, and aid in determining whether broken bones can be set by taping or, if necessary, be pinned. X-rays also can aid in sexing birds provided they are healthy; testes of malnourished birds atrophy. All treated birds are then returned to the Museum for care and rehabilitation. We have found darkened cardboard boxes to be the best housing for injured birds, especially those immobilized by bandages. Wardrobe boxes from moving and storage companies are most desirable. These boxes measure approximately 3 x 3 x 4 feet (90 x 90 x 120 cm). One side is cut to fold down as a top. The bottom is lined with about an inch (2.5 cm) of pine shavings to absorb excrement and to provide a soft surface for the bird to stand or lie on. A darkened box apparently provides the solitude an injured hawk needs to recover quickly; it is also easy to pick up and remove birds from boxes for examination and feeding. All birds that have recovered from injuries and orphaned birds to be trained are fitted with jesses, swivel and leash, and secured to a perch. Wild birds lose their flying strength while recovering from injuries. Their training involves flying them to food at increasing

lengths. In this way they are exercised back to normal or near-normal strength. When the birds are capable of making several 50-yard (45 m) flights before becoming winded, they are ready to be released. We generally try to release them as close to the area in which they were found as possible, except in cases where the likelihood of reinjury is high.

Orphaned birds must be trained differently since, even though they have the innate ability to kill, they must be taught to recognize and subdue living prey. Their training starts with a live rodent leashed to the base of the perch. Most birds in the correct state of hunger will jump down, seize the rodent and eventually kill it, often being bitten in the process. Some will start eating; others lose interest once the prey is dead and jump back up to the perch. Eventually, hunger generally causes these birds to become more interested in eating the next day. Once the young bird looks forward to killing its prey, it is no longer tethered. The bird must then chase and catch its prey. The distance to the prey is increased until the bird will fly about 50 yards (45 m) to kill. In the meantime, the bird has been flown to food for exercise so that it is ready to be released.

Basically, two procedures are used to release orphaned raptors, one for owls and one for all others. Owls seem to be quicker to learn under nocturnal hunting situations.

We use a method called hacking, first used by falconers to return birds to the wild. Training of orphaned owls differs in that not as much time is needed to teach them to kill live food. They are raised in cages and given live mice or rats to kill, but are not taught to fly a distance to kill their food. When the owls are fully grown, the cage door is left open at night and they venture out. Food is left in the cage so that the birds return to their "metal nests" to be fed. Eventually, they fail to return, presumably after learning to hunt on their own. This process takes about a week.

Young hawks are taken to an area with abundant prey for release. They are then perched in the area for a few days in order for them to become accustomed to the area. They are then banded and released. They will venture out for periods of time and then return for food left near the perch or in another spot they have been trained to. Eventually they learn to hunt on their own and do not return for food or return only at increasing intervals.

Banding before release began during the summer of 1971, and as yet no returns have been received. A total of 76 birds have been banded.

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We would like to thank Dr. James R. Koplin and Dr. David Kitchen for help in preparation of this paper, and Terry Tiernan, Bobbie Meyer, Doug Bell, Jim Barbiere, Steve Weir, Doug O'Neal and Barbara Bogue for assisting in raising, training, and releasing the birds in the program. We would also like to give special thanks to the staff at Valley Veterinary Hospital for the time and materials donated to save birds.

RAPTOR REHABILITATION AND CONSERVATION IN MINNESOTA*

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Minnesota contains many areas of good raptor breeding habitat. The open agricultural lands, hardwood forests, coniferous forests, wetlands and combinations of these habitats provide the diversity and productivity necessary to support many species of hawks, owls, and falcons as well as the Bald Eagle and the Osprey. Additionally, the fall and spring migrations funnel thousands of birds through the state each year, and many overwinter. The encroachment of suburban sprawl upon these habitats and exhaustive year-long recreational use of nearly all the state results in numerous human-raptor encounters. This is particularly true in the greater Minneapolis-St. Paul area which lies near the junction of several habitat types.

The dense human population interacting with the raptor population has resulted in many birds being shot, illegally trapped, and taken from nests. Game farms and commercial hunting clubs with their concentration of game species, attract raptors. Shooting and pole trapping have caused the injury or death of many birds. People seeking hawks and owls for pets may take all the birds from a nest and then, with little knowledge of, or experience in caring for, raptors, end up with undernourished, ill, or injured birds. Diseased or injured raptors are often discovered by people hiking, hunting or driving. As a result of these factors a need has existed for a program involving the conservation and rehabilitation of raptors in Minnesota.

In 1971 Fuller began conducting a radio-telemetry study of various aspects of raptor ecology in Minnesota. In order to test the effects of a new transmitter design on the behavior of hawks and owls, injured birds were sought at a local zoo and state game farm. It was readily apparent that there were several sources of injured raptors but that most birds would need professional veterinary care.

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March, 1973.

Dr. Duke, of the University of Minnesota College of Veterinary Medicine, who is conducting gastro-intestinal research on owls, volunteered his help. He also contacted Redig, a veterinary student and falconer, who was eager to apply his professional skill to raptors. It was soon decided to establish a comprehensive program of raptor rehabilitation and conservation.

Initially the effort was all made with the authors' own time and financing. Soon, however, the faculty and staff of several departments were donating time and expertise. This work was a new experience for most, but people have been most cooperative in helping with problems. With this assistance much specialized work, such as radiology and orthopedics, has been accomplished. Financial assistance for various aspects of the program has also been contributed by the Raptor Research Foundation, the Frank M. Chapman Memorial Fund, Duluth Audubon Society, Hawk Ridge Nature Reserve, the Minnesota and St. Paul Humane Societies, a National Institutes of Health Training Grant, the Minnesota Ornithological Union, and other individuals and organizations.

The cooperation of Dr. John B. Moyle and other employees of the Minnesota Department of Natural Resources and Dr. C. A. Swanson, William Halstead and members of the Bureau of Sport Fisheries and Wildlife have greatly contributed to the success of the program. Additionally, members of the various bird clubs in the state, the local humane society, zoo, managers of hunting clubs and several falconers have helped to locate birds and submit them to us. Newspapers, television and radio stations throughout the state have carried requests that residents having injured raptors contact us. These organizations and the news media have also helped spread information regarding the raptors' place in the ecology of the environment, and the laws pertaining to their protection. Cooperation of this nature has been paramount in establishing the program.

To date, these efforts have given results that encourage the continuation of the work. Many people still harbor the misconception that all hawks and owls are poultry killers. Response to newspaper articles and other media has indicated that the public is interested in, and receptive to, information about raptors. Talks to local nature groups, such as the Isaac Walton League, and bird clubs, gave these interested people more specific knowledge about hawks and owls and they in turn pass it on to others. The education of the general public with regard to the raptors' place in the environment may be one of the most important factors in conserving raptor populations.

Professional ornithologists, falconers, educators and state officials have joined in an effort to strengthen the state protection afforded to raptors, and to insure that falconry can continue and contribute to management and conservation efforts. Falconers in the state have been encouraged to organize and cooperate in every way possible. With the present concern for the environment and the esthetic values more and more people are finding in nature, education about raptors can go a long way toward preserving these birds.

Relocation of nuisance hawks and owls has been instituted at two private hunting clubs, and one state game farm. In the past steel pole traps or guns were used to eliminate raptors, but at these three concentration areas for prey species,

the use of a Swedish Goshawk trap proved to be effective in keeping predation down to levels similar to those obtained by the former methods. Two of these areas set and maintained a trap throughout the fall; the third allowed a falconer to trap on weekends. A total of five Red-tailed Hawks, one Cooper's Hawk, 10 Goshawks, two Broad-winged Hawks, two Red-shouldered Hawks and 12 Great Horned Owls were trapped. Dr. H. Meng (1971) provides additional data from a similar project in New York, where the Swedish Goshawk trap was as effective as pole trapping. The Swedish Goshawk trap and the verbail are suited to the needs of these hunting clubs and game farms because they are effective, but need only be checked periodically. Other devices, such as the bal chatri trap and bow-net, require more continuous attention, but can also be used effectively. Once trapped, the raptors were released in suitable habitats away from game concentrations, on nature areas, or in the case of fall migrants, some distance south of the capture site.

We are seeking the assistance of state and federal officials to encourage a switch to humane methods of live-trapping. The pole trap is indiscriminate and exists as a potential danger to all raptors. If a pole-trapped bird does not die in the trap it usually sustains injury. Of 17 pole-trapped Great Horned Owls we have received, only four had injuries minor enough to allow them to be released immediately, four were eventually released, nine were permanently disabled or died as a result of their injuries. Hopefully, future legislation will disuade users of this technique. However, manpower for proper enforcement of laws is seldom adequate. Therefore, the introduction of alternative successful trapping techniques may prove more valuable in saving birds from the gun and pole trap. Falconers, federal bird banders and conservation workers might be encouraged to help trap and relocate raptors. In states where regulations permit, a falconer could obtain a bird, formerly destined to be shot, through such cooperative efforts.

In the past year and a half we have received over 120 injured and diseased raptors from throughout the state. Unfortunately, in the early stages of the project we received birds only after people had tried to care for the birds themselves. These cases were usually beyond help because of advanced stages of disease, shock, malnutrition, or dehydration. As knowledge of our work spread, cases were received soon enough for our treatments to be effective. A total of 90 birds were treated from January 1972 to March 1973 for a variety of illnesses and injuries (Table 1). Thirty of these birds were able to be released again. In addition to receiving many of the common species, representatives of several species such as the Bald and Golden Eagles, Peregrine Falcon, and Gyrfalcon that are uncommon in many parts of the country were also treated (Table 1). Our most frequent patients were Great Horned Owls that were injured by pole traps (Table 1).

The regimens of therapy applied to these birds are in general the same that would be applied to any injured and debilitated animal. Inasmuch as the majority of the birds received had injuries to the extremities, the following discussion

Table 1. Summary of raptor injuries—January 1972 to March 1973.

Species/Injury	Projectile	Pole Trap	Accident	Malnutrition	Disease	Total
Red-tail	8	2	1		2	13
Kestrel				5		5
Red-shoulder	1					1
Broadwing	4			1		5
Rough-leg	1					1
Marsh Hawk	2					2
Sharp-shinned			1			1
Goshawk	5	2	1	1	9	18
Peregrine			1			1
Gyrfalcon			1			1
Bald Eagle	2	2	1			5
Golden Eagle	1					1
Screech Owl	1					1
Barred Owl	3	1	1			5
Long-eared Owl	1		1			2
Snowy Owl	2		2			4
Great Horned Owl	6	17	1			24
Total	37	24	11	7	11	90*

*Raptors treated prior to 1972, and those that died before treatment, or were dead on arrival are not included in this total.

will be confined to a description of the management of these. Our first concern was to stop blood loss. This was best done by locating the source of the bleeding and applying pressure with the fingers until bleeding ceased. Then, the rest of the body was palpated for other injuries such as lacerations or fractures. A swab was usually passed down the esophagus into the stomach to determine if there was hemorrhage in the upper gastrointestinal tract. The debris was cleaned from open wounds, dead tissue was removed, and wounds were packed with antibiotics. At this time we also formulated some notion of the nutritional status of the bird. Broken wings or legs were bound against the body to prevent further injury while the bird was brought through the process of being nutritionally and metabolically stabilized. Only after this stabilization has occurred should one consider subjecting the bird to the stress of surgery to reduce fractures.

To bring about this nutritional stabilization the bird was fed a good high protein diet for several days. Most birds are dehydrated by the time they are received and treatment for this will also have to be considered. In the case of the bird that was dehydrated or could not or would not eat solid food, a slurry consist-

ing of boiled Coke or lactated Ringer's solution, raw eggs, vitamin supplements and finely chopped meat was fed via stomach tube. After a couple of days, light meat such as the breast of pheasant was introduced into the diet, with roughage being given at a later time.

When surgery was indicated for the repair of injuries, we began with radiographs to determine the extent of injuries. A technique consisting of 43 KVP, 300 MA, for 1/20 sec at 40 inches (100 cm) from the table top proved to be satisfactory for the extremities for a bird the size of a Red-tail. A ventral-dorsal shot was usually made, occasionally followed by a lateral view. No anesthesia or sedation was required although the bird often was restrained with masking tape.

For treatments requiring anesthesia we relied almost entirely on ketamine (Ketaset, Parke-Davis) given at a rate of 20-40 mg/lb (44-88 mg/kg). This produced sufficient anesthetization for completion of most procedures. Once anesthetized, the bird could be intubated and put on metofane or halothane and nitrous oxide anesthesia for longer procedures. A Bald Eagle was held in the surgical plane of anesthesia for five hours this way. By using acepromazine (Acepromazine, Ayerst Labs., New York, New York) in combination with ketamine, the dosage of ketamine could be reduced by about 30 percent and a much smoother recovery was produced, i.e. when the anesthetic wore off the birds stood up with little involuntary flapping of the wings or thrashing of the legs. This combination has been used only in a Broad-winged and two Red-tailed Hawks and needs further evaluation. We observed a considerable variation in dose/response with ketamine.

Most fractures involving the extremities were stabilized with intramedullary pinning. Pins were usually left in five to six weeks, but this is dependent on the degree of healing and should be monitored radiographically. Wings were braille for the first two to three weeks and legs could be further stabilized with a modified Schroeder-Thomas splint. Brailling was usually sufficient for fractures of the digits and radius. Stainless steel pins were obtained very cheaply by purchasing stock material from an industrial jobber. The pins then cost about 20 cents instead of the usual $4.00-5.00.

Other than failure to heal due to vascular impairment, there were few complications involved with the surgical corrections of fractures. Infection of the bone was seldom seen. Occasionally an unusually large inflammatory reaction occurred which tended to create a post-surgical arthritis and ankylosis of nearby joints. We believe that this can be controlled to some extent by the local injection of Depro-Medrol (Upjohn), a long acting steroid, once callous formation is well under way.

Many raptors have been saved but left permanently disabled. Our efforts with these individuals have been to place them where they will be most useful. For instance, the North Woods Audubon Center has an excellent educational and exhibition program which gives many people the chance to see these raptors and learn about them. Also, some school systems and nature centers have personnel qualified to care for and speak about raptors. Other hawks, owls, and

falcons have been used in research on physiology, telemetry, diseases, chromosome studies, blood analysis and anatomy studies. Still others have been turned over to captive breeding projects. These permanently injured birds are used to the fullest extent, but they still represent a problem inherent in the medical aspects of rehabilitation.

In addition to the treatment of injuries, much of our effort was involved with the study of and treatment of aspergillosis in Goshawks. Our data came from two sources: a field survey done on wild birds trapped at Hawk Ridge Nature Reserve, Duluth, Minnesota, during an extensive immigration of Goshawks during the fall of 1972, and from clinical cases seen in birds captured by falconers and those injured birds found by people throughout Minnesota.

Table 2 lists the results of the field survey. A total of 49 Goshawks were trapped in bow nets on two different days, October 8 and October 17, 1972, and their tracheas were swabbed. These swabs, cultured on Sabarouds agar, showed that 26 birds had cultures positive for *Aspergillus fumigatus* and 23 were negative. The significance of these results is difficult to assess. For example, in eight captive Goshawks with clinical signs of aspergillosis, five cultured positive for *A. fumigatus,* and three died from the disease; three cultured negative, yet two of these died of aspergillosis anyway (Table 3). Our conclusion is that more than 50% of the population we sampled carried the aspergillus organism and that, as a result, these birds may or may not at some time become ill.

The clinical signs associated with aspergillosis (Table 3) usually began to appear three to four weeks after the Goshawks were shot or captured. This supports the often mentioned hypothesis that the development of this disease is triggered by some stress factor. It is possible that the three to four week period was sufficient time for pulmonary infection to occur and to bring about the clinical signs of aspergillosis. The excreta of infected birds were watery in nine

Table 2. Incidence of aspergillosis in wild Goshawks.

Incidence	Males Imm.	2 yr.	Adult	Females Imm.	2 yr.	Adult	Totals
October 8, 1972.							
+	1	3	2	2	7	6	21
-	4	2	2	0	2	2	12
October 17, 1972							
+	0	2	2	0	1	0	5
-	1	2	2	1	3	2	11

Total 26+, 23-

Table 3. Clinical signs of aspergillosis in Goshawks.

Signs	Number of birds observed.
Culture on Sab-Dex	5/8 +; 3 died 3/8 -; 2 died
Watery feces	9/12
Excess pale green pigment in feces while engorged	10/12
Weight loss	12/12
Dyspnea	12/12
Anorexia with regurgitation when force fed	12/12
Death	8/12

out of 12 cases; watery to the point where a large puddle up to three feet in diameter would form on the floor within a day. Most of these excreta were infiltrated with a pale green pigment, presumably bile. We have observed that normal birds often excrete bile when hungry, but these birds with aspergillosis had sickly green excreta while there was still ample food in the digestive system. Weight loss in these birds was dramatic. For example, a female Goshawk weighing 2 lbs 11 ozs (1216 g) dropped to 2 lbs 4 ozs (1020 g) in 48 hours. Respiratory difficulty occurred within three days of the first signs. The first sign often was an unusual response to normal activity; later birds began to gasp for air while just sitting quietly on a perch. Shortly thereafter the birds usually stopped eating. Force feeding was effective for one to two days, but then birds began to regurgitate food. Fluids were better retained than solids at this point. Death usually ensued in three to five days after the birds stopped eating. The whole course of the disease has been noted to run from five to eleven days. It should be pointed out that these signs are not specific for aspergillosis, but could be indicative of any debilitation disease. However, if an American Goshawk is showing these signs, we believe that chances are very good that it is indeed afflicted with aspergillosis.

Therapy with Amphotericin B (Fungizone, Squibb and Sons) was instituted for all 12 cases mentioned above (Table 3). It was administered intravenously in the cutaneous ulnar vein at a rate of 0.75 mg/kg and via nebulization with a hand nebulizer. Eight of the birds treated subsequently died while four survived. The latter four were given I.V. injections every other day and nebulization treatment for one hour per day every day. The original diagnosis was confirmed by necropsy among the eight that died. Those that survived were falconer's birds and were not sacrificed to confirm the original diagnosis or to ascertain the degree of remission. Supportive therapy is also an important part of any treatment regimen and in these four cases it consisted of maintaining the fluid, caloric, and acid-base balances of the bird using the slurry described above.

A regimen of prophylaxis was also tried using five captive Goshawks. This consisted of an initial injection of Amphotericin B followed by daily nebulization for one week. The birds were initially swabbed to check for *A. fumigatus* prior to treatment and swabbed again after two weeks. Three were positive prior to treatment and none were positive afterwards (Table 4). It should be noted that the five birds treated here were all trapped much later in winter, i.e. after January 1, and they might represent a resistant segment of the population that had survived the period of stress associated with the fall immigration and readjustment to new habitat.

Table 4. Prophylaxis with aerosol Amphotericin B.

Bird Number	Culture 1*	Culture 2**
1	+	-
2	+	-
3	-	-
4	+	-
5	-	-

*Prior to prophylaxis with Amphotericin B.
**Subsequent to prophylaxis with Amphotericin B.

These initial observations on aspergillosis have raised many questions. To answer some of these, an experiment is now being prepared utilizing Coturnix Quail. The goals of this experiment are: (1) to develop an early diagnosis technique through the use of serum antigen-antibody agglutination reactions; (2) to evaluate regimens of therapy; (3) to evaluate programs of prophylaxis. Basic information obtained from these experiments will then be applied in experimental work that utilizes some of the crippled hawks we have.

In conclusion, the following points can be made concerning rehabilitation:

1. It is of definite value to the individual bird that is returned to the wild.
2. Such a program has sufficient merit to attract public attention, thereby making people aware of the birds and of the problems complicating their survival.
3. It provides basic knowledge and expertise so that rare and endangered species can receive more competent attention.
4. Rehabilitation programs provide a source of birds for research work and educational programs.
5. A program which incorporates careful scientific observations and experimental testing of hypotheses formulated by these observations, can provide much useful information about the biology of raptors and thus contribute to their management and conservation.

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THE USE OF THE STEROID ANAESTHETIC CT 1341 IN BIRDS*

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Introduction

Despite extensive work on mammals there is a shortage of accurate data on the anaesthesia of birds. Those publications which exist frequently fail to supply information on the methods used to assess the depth of anaesthesia, as was emphasized by Jordan, Sanford and Wright (1960). Birds have a high metabolic rate and a specialized respiratory system and hence frequently react poorly or adversely to agents which cause sedation or anaesthesia in mammals (Arnall 1964).

Efficient anaesthesia of birds is frequently of value to the veterinary surgeon. The fowl and other domesticated species are only rarely anaesthetised when kept for commercial purposes, but as laboratory animals they frequently require immobilisation or anaesthesia for experimental techniques.

In small animal practices a number of exotic birds may be presented for surgery and here a suitable anaesthetic is essential. The predatory birds can be particularly difficult and dangerous to handle and an anaesthetic agent may be desirable for even minor procedures.

The various agents available for the anaesthesia of birds of prey were discussed by Cooper (1970) and Houston and Cooper (1973) who concluded that a number were unsuitable for these species. These authors recommended the hypnotic agent metomidate (Janssen Pharmaceutica) by intramuscular injection for predatory birds.

During the course of work in Kenya it was necessary to anaesthetise wild and

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captive birds of prey for veterinary purposes and also to perform pectoral muscle biopsies for chlorinated hydrocarbon insecticide analysis as described by Siedensticker (1970). Initially, the biopsies were carried out using intramuscular metomidate, but the recovery period with this drug frequently proved too long and the anaesthetised birds often salivated excessively, even if atropine was administered. As a result of these disadvantages, another, shorter-acting drug was investigated.

This was CT 1341, a steroid anaesthetic which has been successfully used in humans and which is available commercially for use in cats (Evans, Aspinall and Hendy 1972). The pharmacological properties of CT 1341 were described by Child *et al.* (1971) who investigated its anaesthetic activity in a number of mammals including rodents, cat, dog, and monkey. These authors drew attention to the rapid and uncomplicated induction and recovery in all species investigated using the drug. It had a high therapeutic index and could be used safely in conjunction with premedicants, volatile anaesthetics and muscle relaxants. One very significant advantage of CT 1341 was that, unlike thiopentone sodium, intra-arterial injection was not associated with severe oedema and necrosis. Use of CT 1341 is not, however, recommended in the dog, as it can produce undesirable "allergic" responses such as erythema and urticaria.

CT 1341 is a clear, slightly viscous solution. Each ml contains 12 mg of total steroids, composed of 9 mg alphaxolone and 3 mg alphadolone acetate.

Methods

After initial testing in domestic poultry (Cooper and Frank 1973) CT 1341 was used in 26 captive and recently caught birds of prey of 16 species and varying weights. The drug was injected undiluted (12 mg/ml active ingredient) into the brachial vein with a 25 or 26 gauge needle while the hooded bird was held supine with one wing extended by an assistant. The injection site was first cleaned with 70% methanol.

Depth of anaesthesia was assessed by the response to pressure (squeezing of the foot) and pain (pricking of the skin of the face with a narrow gauge needle). As was the case with Jordan, Sanford and Wright's (1960) work, the corneal reflex proved unsatisfactory.

Results

The results obtained with raptors are summarized in Table 1.

In each case the bird's weight is given, together with the dosage of CT 1341. The latter is expressed both in terms of volume and mg/kg body weight. The weight was assumed constant in cases where a bird was injected more than once.

In the results, "hypnosis" is defined as a stage where the bird was unable to stand, but responded to pressure and pain. In the case of "deep hypnosis" the response was only slight, while "anaesthesia" implies that there was no response at all to these stimuli.

The "duration" of action is the interval between the giving of the injection and the bird's being able to stand and respond to stimuli. In all cases the period

Table 1. Use of CT 1341 in birds of prey.

Species and weight (g)	No.	Dosage	Route	Result	Duration	Purposes and Comments
(1) Harrier Hawk (*Polyboroides typus*) 860	1	0.55 ml (8 mg/kg)	i-v	Immediate anaesthesia	8½ mins.	Routine examination of plumage.
	1	0.5 ml (6.9 mg/kg)	i-v	Immediate anaesthesia	10 mins.	As above.
(2) Harrier Hawk 690	1	0.4 ml (7 mg/kg)	i-v	Immediate anaesthesia	11 mins.	As above.
	1	0.3 ml (5 mg/kg)	i-v	Immediate anaesthesia	8 mins.	As above.
(3) Tawny Eagle (*Aquila rapax*) 2800	1	1.5 ml (7 mg/kg)	i-v	Immediate anaesthesia	Approx. 12 mins.	Examination of leg injuries.
	1	1.5 ml (7 mg/kg)	i-v	Immediate anaesthesia	Approx. 12 mins.	X-ray of fractured leg. Bird in poor condition.
	1	1.75 ml (8 mg/kg)	i-v	Immediate anaesthesia	14 mins.	Taking of biopsy from pectoral muscle.
	1	1.75 ml (8 mg/kg)	i-v	Immediate anaesthesia	9 mins.	Fracture of tibia broken down and plastered.
(4) African Hawk Eagle (*Hieraaetus fasciatus spilogaster*) 1310	1	1.0 ml (9 mg/kg)	i-v	Immediate anaesthesia	7 mins.	Examination of biopsy wound.

Table 1. (continued)

Species and weight (g)	No.	Dosage	Route	Result	Duration	Purposes and comments
(5) Lizard Buzzard (*Kaupifalco monogrammicus*) 290	1	0.2 ml (8 mg/kg)	i-v	Immediate anaesthesia	8 mins.	Examination of biopsy wound.
	1	2.0 ml (82 mg/kg)	i-p	Anaesthesia within 15 secs., dead within 8 mins.	—	Injection entered air sac. Bird died.
(6) Lizard Buzzard 260	1	1.0 ml (46 mg/kg)	i-p	No effect.	—	Routine examination. No effect.
	1	0.5 ml (23 mg/kg)	i-p	No effect.	—	Routine examination. No effect.
	1	0.25 ml (11.5 mg/kg)	i-v	Immediate anaesthesia	5 mins.	Fracture of radius ulna broken down and splinted.
	1	1.0 ml (46 mg/kg)	i-m	Light hypnosis within 15 mins.	50 mins.	Removal of splint from wing.
(7) White-backed Vulture (*Gyps africanus*) 4970	1	1.4 ml (3.3 mg/kg)	i-v	Immediate anaesthesia	19 mins.	Examination and taking of blood sample.
(8) Spotted Eagle Owl (*Bubo africanus*) 620	1	0.3 ml (5.8 mg/kg)	i-v	Immediate anaesthesia	11 mins.	X-ray of wing fractures, trembling apparent.
	1	0.35 ml 6.7 mg/kg)	i-v	Immediate anaesthesia.	Approx. 13 mins.	X-ray of wing fractures, trembling apparent.

Table 1. (continued)

Species and weight (g)	No.	Dosage	Route	Result	Duration	Purpose and comments
(9) African Goshawk (*Accipiter tachiro*) 330	1	0.25 ml (9 mg/kg)	i-v	Immediate anaesthesia	8 mins.	Routine examination and x-ray of leg.
(10) Barn Owl (*Tyto alba*) 300	1	0.18 ml (7.2 mg/kg)	i-v	Immediate anaesthesia	13½ mins.	X-ray of wing fracture.
(11) Hooded Vulture (*Necrosyrtes monachus*) 1800	1	0.8 ml (5.3 mg/kg) followed by 0.5 ml (3.3 mg/kg) after 4 mins.	i-v	Immediate hypnosis after first injection but soon began to lighten. Similar hypnosis after second injection	10 mins. from first injection	X-ray of leg fracture.
	1	1.3 ml (8.6 mg/kg)	i-v	Immediate anaesthesia	6 mins.	Taking of blood samples. Compare result with divided doses above.
(12) African Fish Eagle (*Haliaeetus vocifer*) 2000	1	1.0 ml (6 mg/kg)	i-v	Immediate anaesthesia	5 mins.	Removal of ectoparasites. Wing trembling apparent.
(13) Pale Chanting Goshawk (*Melierax canorus*) 500	1	0.4 ml (9.6 mg/kg)	i-v	Apnoea for one min. Anaesthesia.	30 mins.	Routine examination and removal of ectoparasites. Freshly caught bird.

Table 1. (continued)

Species and weight (g)	No.	Dosage	Route	Result	Duration	Purposes and comments
(14) Lanner (*Falco biarmicus*) 650	1	0.4 ml (7.3 mg/kg)	i-v	Immediate anaesthesia	31½ mins.	Pectoral muscle biopsy. Freshly caught bird.
(15) Black Kite (*Milvus migrans*) 590	1	0.3 ml (6 mg/kg)	i-v	Immediate anaesthesia	5 mins.	X-ray of body.
(16) Dark Chanting Goshawk (*Melierax metabates*). Not weighed (adult).	1	0.4 ml (?)	i-v	Immediate anaesthesia	25 mins.	Pectoral muscle biopsy. Freshly caught bird.
(17) Augur Buzzard (*Buteo rufofuscus*) 1325	1	0.9 ml (8.1 mg/kg)	i-v	Immediate anaesthesia	15 mins.	Pectoral muscle biopsy. Freshly caught bird.

of apparent analgesia was considerably less.

The only predatory birds injected by intramuscular or intraperitoneal routes, Lizard Buzzards (5 and 6) showed similar results to poultry by the former, but 23 mg/kg produced only slight sedation and incoordination lasting 35 minutes. Neither 23 mg/kg nor 46 mg/kg had any effect by the intraperitoneal route in one of the Lizard Buzzards (6) and this is possibly because the bird was very fat and the CT 1341 may have entered abdominal fat, rather than the body cavity, and been absorbed slowly.

In the case of the other Lizard Buzzard (5) which was equally fat, a dose of 2 ml (82 mg/kg) killed the bird, this being the only fatality among the birds of prey. Death was due to the needle inadvertently entering an abdominal air sac. The bird spluttered immediately, lost consciousness within 15 seconds, and brought up fluid (probably the drug) through the trachea. Despite attempts to revive it, the bird deteriorated and died within three minutes. This accident emphasizes the importance of care when giving CT 1341 by the intraperitoneal route: in the case of the Lizard Buzzard the injection was given single-handed and hence positioning of the needle was not perfect.

Intravenous administration in birds of prey produced rapid loss of consciousness and apparent analgesia which usually lasted less than five minutes. Such analgesia was sufficient to permit considerable painful manipulation including, in the case of the Tawny Eagle (3), Lanner (14), Dark Chanting Goshawk (16) and Augur Buzzard (17) the taking of a biopsy from the pectoral muscles. The prime advantage of the intervenous route was the rapid recovery, the bird usually showing the return of pedal reflexes within four minutes. The speed at which CT 1341 is metabolized in birds is indicated by the different responses in the Hooded Vulture (11) when 1.3 ml were given in single and divided doses.

The Tawny Eagle received four intravenous injections of CT 1341 in 13 days with no obvious ill effects. The Spotted Eagle Owl (8) and African Fish Eagle (12) both showed wing trembling while anaesthetised, but this did not hamper work and was not seen in other species.

The administration of intravenous doses of 14 mg/kg or over in chickens usually resulted in deaths; no fatalities occurred at less than this dosage. In birds of prey, doses of up to 10 mg/kg produced satisfactory anaesthesia.

In most cases the bird had fully recovered within 15 minutes and was feeding soon afterwards (within 20 minutes in the case of the African Goshawk (9)). This was in contradistinction to the effect of metomidate under which birds took several hours to recover and, in the case of some wild-caught specimens, were still very dazed and anorectic 18 hours later. The Pale Chanting Goshawk (13), Lanner, Dark Chanting Goshawk and Augur Buzzard were all injected with CT 1341 within 36 hours of capture. Recovery was prolonged and this was attributed to their not having eaten during this time. All fed readily within one hour of the injection.

The small dose used to anaesthetise the White-backed Vulture (7) and the bird's slower recovery suggest that, as with metomidate (Houston and Cooper 1973), the larger vultures may require smaller doses than other predatory birds,

but further investigation is needed. The Hooded Vulture, a small species, needed a comparable does to other non-vulturine species.

Discussion

The results indicate that CT 1341 has a place in avian anaesthesia. It is suggested that, used intravenously, it offers a suitable alternative to metomidate, particularly when an ultra-short-acting agent with a rapid recovery is required. Examples of its use are the taking of a biopsy, radiography and, possibly, induction of anaesthesia prior to maintenance with a volatile agent. CT 1341 appears to be a safe drug, even in recently captured birds of prey unaccustomed to handling. Administration of the drug by the intravenous route necessitates manual restraint of the bird, but the brachial vein is easily found and the injection rarely poses problems if a narrow gauge needle is used. In the case of birds of prey the use of a hood considerably facilitates handling. The suggested intravenous dose of 10 mg/kg for birds is comparable with that of 9 mg/kg recommended for intravenous anaesthesia in the cat.

By intraperitoneal or intramuscular routes, CT 1341 produces immobilisation, but analgesia is poor. The duration of such immobilisation is proportional to dosage. By such routes CT 1341 has certain advantages over metomidate; a larger volume of the former must be given to produce similar results, but recovery is smoother and quicker. Intraperitoneal CT 1341 is probably of value for use in small birds, for non-painful procedures such as the examination of plumage and removal of ectoparasites.

Care should be taken, however, to avoid injecting into the abdominal air sac and it is probable that absorption of the drug is retarded if it enters abdominal fat. The failure of an intramuscular dose of 30 mg/kg to affect one chick suggests that, as in cats (Evans, Aspinall and Hendy 1972), injection of the drug between the fascial planes of a muscle may render it inactive.

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FURTHER NOTES ON THE USE OF CT 1341 IN BIRDS OF PREY

by
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CT 1341 ("Saffan", Glaxo Laboratories) was further tested on seven North American raptors. Due to reports of a possible but unproven adverse cardiac effect in cats (Edmonds 1973, Evans 1973, Evans and Austin 1972, Marshall 1972), heart and respiration rates were monitored immediately before and at intervals after intravenous injection of CT 1341. Methods were the same as in Cooper and Frank (1973); heart rate was monitored by stethoscope and respiration was counted visually.

Results

1. Golden Eagle (*Aquila chrysaetos*) OY 1100.
    Weight: 3460 g.
    Heart rate: 336
    Resp. rate: 32
    Dose: 1.0 ml (3.47 mg/kg)
   1.25 min.: eyes still open, struggling.
    Heart: 190 normal rhythm
    Resp.: 100
   2.5 min.: alert.
    Heart: 140, normal
   5 min.: standing.
    Heart: 240, abnormal rhythm
   Recovery uneventful.

2. Red-tailed Hawk (*Buteo jamaicensis*) OY 1545.
    Weight: 1170 g (low condition, one wing missing).
    Heart: 220
    Resp.: 60
    Dose: 0.8 ml (8.20 mg/kg)

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2.5 min.: No response to stimulation.
Heart: 180, abnormal rhythm
Resp.: 72
4.5 min.: leg and wing tremors.
6.25 min.: Heart: abnormal rhythm.
Resp.: 64
7.25 min.: eyes open
12.5 min.: standing
Heart: 200, normal rhythm
Recovery uneventful.

3. Red-tailed Hawk No. 2.
Weight: 1300 g.
Heart: 336
Resp.: 60
Dose: 1.0 ml (9.23 mg/kg)
1.5 min.: Heart: 170, abnormal rhythm
Apnea
2.5 min.: Heart: 120, weak
Apnea
3 min.: Heart stopped, bird died.
Post-mortem examination showed a focal hepatitis and hepatic cyst.

4. Red-tailed Hawk (immature) OP 1546.
Weight: 965 g (one wing missing)
Heart: 360
Resp.: 53
Dose: 0.6 ml (7.46 mg/kg)
0.5 min.: resumed breathing.
5 min.: no response to stimulation, flaccid.
Heart: 320+, abnormal rhythm.
Resp.: 80
7.5 min.: Resp. 44
8 min.: no response to stimulation, shivering.
9 min.: response to stimulation.
10.5 min.: eyes open.
11.5 min.: standing.
Recovery uneventful.

5. Great Horned Owl (*Bubo virginianus*) OY 1087.
Weight: 1090 g (broken wing)
Dose: 0.3 ml (3.30 mg/kg)
1 min.: no response to stimulation, wing tremors, eyes open.
2.5 min.: response to stimulation.
10 min.: struggling, unable to stand.

17 min.: standing
Recovery uneventful.

6. Short-eared Owl (*Asio flammeus*) OY 0797
   Weight: 325 g (missing left wing)
   Heart: 180
   Resp.: 58
   Dose: 0.15 ml (5.54 mg/kg)
   0.5 min.: Heart: 190, normal rhythm
   1.5 min.: Heart: 240, normal
   Resp.: 40
   Eyes open.
   2 min.: no response to stimulation.
   7 min.: no response to stimulation, slight wing tremors.
   8 min.: response to stimulation.
   Heart: 240
   15 min.: alert but unable to stand.
   17 min.: standing.
   Recovery uneventful.

7. Short-eared Owl OP 1543
   Weight: 310 g (missing right wing)
   Heart: 420
   Resp.: 50
   Dose: 0.15 ml (5.80 mg/kg)
   40 sec.: Heart: 160, normal
   2 min.: Heart: abnormal rhythm
   4 min.: Heart: 240, normal rhythm
   5 min.: Heart normal
   Resp.: 30
   8 min.: no response to stimulation, body tremors.
   10.5 min.: response to stimulation.
   14 min.: struggling, alert.
   20 min.: standing.
   Recovery uneventful.

Discussion

These results are essentially similar to those obtained from African raptors; the weak effects on the Golden Eagle and Great Horned Owl were due to the light doses administered.

Abnormal cardiac rhythms were observed in six of the seven birds; the one exception was Short-eared Owl No. OY 0797, which received a dose only slightly lower than No. OP 1543 (5.54 mg/kg vs. 5.80 mg/kg). The arrhythmis was characterized by periods of very rapid fibrillation-like "flutter", often apparently superimposed on normal sinous rhythm. Normal rhythm was usually restored

by the time the bird showed response to stimulation; only in the case of the Golden Eagle was an abnormal rhythm detectable after the bird was able to stand.

The death of Red-tailed Hawk No. 2 was the first encountered using intravenously injected CT 1341; previously, a Lizard Buzzard (*Kaupifalco monogrammicus*) had succumbed after inadvertent injection of a heavy dose (82 mg/kg) into an abdominal air sac. The Red-tail failed to recover from the apnea that often occurs immediately after intravenous injection of CT 1341; normally the bird starts breathing again within 30 seconds, but in this case the heart gradually slowed and weakened, and breathing never resumed. *Post-mortem* examination showed that the bird had a focal hepatitis and a large hepatic cyst of unknown origin; death was probably associated with the liver's impaired ability to metabolize the steroid.

Because alphaxalone, the main component of CT 1341, bears a superficial resemblance to progesterone, discretion should be used in administering the drug to raptors being used in breeding experiments until more is known of its endocrinological effects in birds. Childe *et al.* (1972) tested it on rodents and reported weak antiuterotropic effects on the mouse, but no effect on growth, fertility or parturition of heavily dosed females. Offspring of tested animals were normal and fertile.

Acknowledgments

We would like to express our appreciation to Dr. Hal Markowitz, Dr. Michael Schmidt, and Mr. Donald Kerr of the Oregon Zoological Research Center at the Portland Zoo for their kind cooperation and assistance in this work, and to Dr. J. A. Schmitz for his histopathological report.

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A REPORT ON THE USE OF A PECTORAL MUSCLE BIOPSY IN THE FIELD FOR ORGANOCHLORINE RESIDUE ANALYSIS*

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Introduction

In the course of a survey of organochlorine residues in East African raptors in 1971-72, we found that a large proportion of trapped birds had insufficient fat reserves to allow a subcutaneous fat biopsy (Enderson and Berger 1968). As we were unwilling to collect raptors to take tissue samples, we decided to adopt the method of Seidensticker (1970) for taking biopsies of the pectoral muscle, as this technique is no more complex or time-consuming than the fat biopsy. He reported no significant impairment in captive Red-tailed Hawks (*Buteo jamaicensis*) and Golden Eagles (*Aquila chrysaetos*), and, after testing it on captive birds in Kenya, we used the technique on 10 birds that were subsequently released.

Methods

To obtain the sample, the bird is hooded and held by an assistant while it is injected with anesthetic; we at first used metomidate (Hypnodil, Janssen Pharmaceutica) but found that this agent kept the bird sedated far longer than necessary to accomplish the biopsy, and excessive salivation necessitated constant swabbing of the pharynx to prevent choking and gagging on saliva. We then switched to CT 1341 (Saffan, Glaxo Ltd.) (Cooper and Frank 1973) which proved ideal, as it induces surgical anesthesia immediately upon intravenous injection, causes no salivation or other complications, and the bird is fully recovered (responds normally to stimuli, able to stand, perch, and fly) within 30 or 40 minutes of injection.

The anesthetized bird is laid on its back, the keel region wetted with ethanol, and the feathers parted to expose a patch of skin about 2 cm wide by 3 cm

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long lateral to the most ventral point of the sternum; the size of the bared patch depends upon the size of the bird, and a few feathers can be plucked if necessary. After the skin has been cleaned with an alcohol swab, an incision 2.5 cm long is made 8-10 mm lateral to the ridge of the sternum, and the skin spread apart to expose the pectoralis muscle and overlying fat (if any). An incision is then made in the muscle parallel to the keel, 2 cm long and 3-4 mm deep; this incision will widen as a result of muscle tonus. A second incision is then made in the muscle, parallel and 4 mm dorsolateral to the first and angled toward it, to free a prism-shaped strip of muscle which can be lifted out with forceps. These measurements refer to a bird the size of a Golden Eagle and can be adjusted to a larger or smaller bird.

If performed on the suggested site on the breast, there is little or no hemorrhage; the few drops of blood that may appear can be removed with an alcohol sponge and a few seconds of light pressure with the sponge will stop the bleeding. The entire wound is then sprinkled with tetracycline powder, and the skin sutured by two or three mattress sutures, using size 00 gut. The sutured wound is then smeared with furacin ointment or sprayed with calloidin wound dressing and the parted feathers laid over the bare skin. With a little experience, the entire procedure can be carried out in well under ten minutes.

Results

Unfortunately, we did not have an accurate balance available and were unable to weigh the biopsy samples. Seidensticker (1970) reported average weights of .03 g for Red-tailed Hawks and 0.5 g for Golden Eagles.

Sixteen birds of nine genera were biopsied; of these, 10 were released at the site of capture within three days of surgery, and six were kept in captivity for varying lengths of time. In five cases we were able to observe biopsied birds for several days or weeks after release; in only one instance was there any overt abnormal behavior or sign of ill-health; this was a White-backed Vulture (*Gyps africanus*) from which had been removed a biopsy of approximately .8 g. It had been anesthetized with metomidate and was released the next day, 22 hours after surgery. Vultures had proven exceptionally sensitive to metomidate (Houston and Cooper 1973) and this one appeared rather groggy and unstable, though it flew off about 0.5 km and perched awkwardly in an acacia tree. It stayed in the vicinity for the next 24 hours, but had flown off 48 hours after release. As vultures have taken as long as 72 hours to recover from metomidate, we felt that this one's reluctance to fly was due to the effects of the anesthetic rather than to pain from the biopsy wound.

In no other case did a released bird show any reluctance or inability to fly normally; of the six birds kept in captivity after surgery, four had previously been trained to fly at least five meters to the fist for food and none showed any hesitation to do so or to bate on the day following surgery. With the exception of the vulture, all birds observed after surgery, whether captive or released and observed subsequently, behaved normally and appeared healthy. Two immature African Fish Eagles (*Haliaeetus vocifer*) were seen near the point of release two

and six weeks after surgery, and one Augur Buzzard (*Buteo rufofuscus*) was in attendance on its home territory for at least three months after release.

Discussion

The biopsy procedure as outlined above departs from the one described by Seidensticker only in the recommendation that the wound be sutured. He was using captive birds that were kept on perches and (presumably) fed dead food and he reported better wound healing and less infection if the incision in the skin was not sutured. On the contrary, we found that the wound healed more neatly if sutured, and felt that a hawk or eagle in the wild, exposed daily to the rough and tumble of capturing prey, stood a greater chance of getting foreign matter in an unsutured wound and, subsequently, a greater chance of infection. The single occurrence of infection in any of the captive birds we biopsied was in an unsutured Tawny Eagle (*Aquila rapax*) that was often recumbent due to a leg injury, and was therefore more likely to contaminate the wound than a healthy bird perched upright. This was the single case of complications in any of the wounds we observed after biopsy, and we felt it was sufficient grounds to suture any bird that may be exposed to foreign matter at the site of injury. As this possibility can never be eliminated, we recommend that the wound always be sutured, leaving at most a 3 mm gap at the posterior end of the wound for drainage.

The position of the incision is important, because the skin at the suggested site is not heavily vascularized, and hemorrhage is minimal. In the one instance when we departed from this site and made the incision further posterio-lateral on a Lanner Falcon (*Falco biarmicus*), there was heavy cutaneous bleeding that could have resulted in the loss of the bird.

With the exception of the one Tawny Eagle, recovery in all birds kept captive after surgery was uneventful; wound healing was rapid, complete in ten days, and the sutures fell out or were absorbed in three or four weeks.

The one possible disadvantage to using the pectoral muscle biopsy in raptors such as falcons or accipiters which are entirely dependent on high speed precision flight in hunting is that slight damage to the pectoral muscle may temporarily impair their powers of flight sufficiently to decrease hunting success. While we had no evidence to support this possibility, we felt it advisable to keep and feed all biopsied birds for at least 24 hours, and at least 72 hours in the case of falcons and accipiters. Birds less dependent on powerful flight such as Tawny Eagles, chanting goshawks (*Melierax* spp.), Augur Buzzards, White-backed Vultures, and African Fish Eagles, were released the day after surgery. On one occasion, a Pale Chanting Goshawk (*Melierax canorus*) had to be released as soon as it had recovered from the anesthetic (CT 1341); it flew off immediately and perched nearby. It was observed hunting in its home range the next day.

Because there might be slight impairment of flying abilities that is of no great consequence in normal circumstances, but that may become significant in times of increased flying activity, as in the case of a bird that is migrating or feeding nestlings, it is probably not advisable to perform the pectoral muscle biopsy on birds in either of these circumstances until we have sufficient data to show that

it has no effect on flying prowess or endurance even under conditions of stress. This could possibly be tested by performing surgery on a trained falcon and testing its ability to stoop at a lure or fly in a wind tunnel for prolonged sessions following biopsy.

Seidensticker (1970) reported organochlorine residue values obtained from biopsy samples to be more variable than whole muscle samples, and that the biopsies contained a higher percentage of extractable lipids. Biopsy values for DDT and metabolites were 17% lower than whole muscle samples in DDT-dosed Red-tailed Hawk fledglings, and he states that ". . . chlorinated hydrocarbon residues found in muscle samples which were taken via the biopsy should be viewed as estimates of the contents of the entire tissue rather than as absolute values." The present authors concur with this opinion, but propose that further experimental studies be undertaken with a larger sample size of dosed birds in the hope of establishing a relatively constant relationship between residue levels found in the biopsy samples and whole muscle.

Summary

The pectoral muscle biopsy technique reported by Seidensticker (1970) was used in captive and wild raptors of nine genera as part of a pesticide residue survey in Kenya. It proved equally simple to perform in the laboratory or under field conditions, and there was no discernible impairment of flying abilities in 15 of the 16 birds biopsied. In the one exception, the reluctance to fly was attributed to after-effects of the anesthetic rather than the biopsy, and the one instance of infection in a bird that was kept in captivity after surgery was apparently due to contamination of the unsutured wound. It is suggested that the wound always be sutured to prevent infection in released birds and the advisability of performing any muscle surgery on a bird that is migrating or feeding young is questioned. More data on the relationship between residue levels in biopsies and whole muscle are needed.

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REPORT:

PROCEEDINGS OF THE CONFERENCE ON RAPTOR CONSERVATION TECHNIQUES, FORT COLLINS, COLORADO, 22-24 MARCH 1973

Part 5. REHABILITATION AND PATHOLOGY

edited by
Byron E. Harrell

This session of the Conference on Thursday evening, 22 March, 1973, consisting of seven papers, was organized and chaired by David Graham. Five papers were completed for publication in this issue of *Raptor Research;* one had previously been published and is reprinted here with permission, and an additional paper extending the research in that paper is included here. Dr. Graham also edited the papers for this issue. An additional abstract and a list of the papers as presented are included below.

With publication of Part 6, the Proceedings are complete. Of the 74 papers, 44 were published in the following parts.

Part 1. Introduction. *Raptor Research* 7(2):55-61, 1973.
Part 2. Raptor Ecology. *Raptor Research* 7(2):25-54, 62-69, 1973 (papers 1-7, 44a).
Part 3. Raptor Research Techniques. *Raptor Research* 7(3/4):73-104, 114-118, 1974 (papers 65-73).
Part 4. Management of Raptors. *Raptor Research Report* No. 2, 146 pp., 1974 (papers 45-64).
Part 5. Rehabilitation and Pathology. *Raptor Research* 8(1/2):1-44, 1974 (papers 23-29).
Part 6. Population Status of Raptors. *Raptor Research Report* No. 3, over 200 pp., 1975 (papers 8-22, 30-44).

The papers presented in the Rehabilitation and Pathology Session are listed below. Addresses follow original program.

23. *J. E. Cooper,* Veterinary Research Laboratory, P. O. Kabete, Kenya.
Current Work on Raptor Diseases in Kenya, East Africa [read by David Graham; published in *Raptor Research* 8(1/2):1-5, 1974].

24. *James Wisecarver,* School of Natural Resources, California State University, Humboldt, Arcata, California 95521.
Rehabilitation and release of injured and orphaned predatory birds [published in *Raptor Research* 8(1/2):6-10, 1974, with Gary Bogue as junior author and a changed title].

25. *Roger Thacker,* Department of Animal Laboratories, Wiseman Hall, Ohio State University, Columbus, Ohio 43210.
Raptor Rehabilitation

ABSTRACT. Within the last few years there has been increasing interest in the field of raptor rehabilitation. Whereas up to very recently such work was being carried on mainly by private persons and groups, both regional federal and several state agencies are now moving into this area, some by themselves and others by cooperative agreements.

By means of a national survey a guide is presented on origins of injuries to raptors and the possible importance of these, if any, to the species. Figures are presented on rehabilitation work being carried out in the United States and the success being obtained by those carrying out the work. Individual case histories of interest will be presented, and techniques which have proven successful and which have been pioneered very recently or are in experimental stages will be discussed.

26. *Mark R. Fuller,* Department of Ecology and Behavioral Biology, University of Minnesota, Minneapolis, Minnesota 55455, *Patrick T. Redig,* and *Gary E. Duke.*
Raptor rehabilitation and conservation in Minnesota [published in *Raptor Research* 8(1/2:11-19, 1974].

27. *J. E. Cooper* and *Laurence Frank,* 101 Reservoir Road, Hillsborough, California 94010.
A rapid acting injectable anesthetic for raptors [reprinted from *Veterinary Record* 92:474-479, 1973, in *Raptor Research* 8(1/2):20-28, 1974; further information is in another paper by L. G. Frank and J. E. Cooper, *Raptor Research* 8(1/2):29-32, 1974].

28. *Laurence Frank* and *J. E. Cooper.*
A report on the use of a pectoral muscle biopsy in the field for organochlorine analysis [published in *Raptor Research* 8(1/2):33-36, 1974].

29. *David Graham,* Department of Veterinary Pathology, College of Veterinary Medicine, Iowa State University, Ames, Iowa 50010.
A discussion of current pathological findings relevant to raptorial birds.

The following transcription of the Rehabilitation and Pathology Session discussion period was edited for clarity and redundancy and irrelevancy and was

reorganized in sequence. Two additional informal sessions on this topic were held but no recording was available.

Biopsy Incision Technique

DAVID GRAHAM. Did I understand you correctly, Mr. Frank, that the incision is made parallel to the keel?

LAURENCE FRANK. Right.

GRAHAM. Well, in muscle biopsies for whatever purpose they are taken, one technique that I have used in birds as well as mammals and is widely used in human biopsies is to perform the incision parallel with the lines of muscle fiber formation. In this manner you reduce the damage to a rather small bundle of muscles rather than cutting across a rather large number of bundles. Now I don't know if in fact in doing it this way I'm giving this bird a better chance to survive with maximal muscle effect. I don't know, but it seems to be a bit more physiological than cutting across a rather large number of muscle fibers. I am saying, make the incision in the superficial pectoral muscle perpendicular or actually at a slight angle parallel to the muscle fibers. The muscle fibers tend to go off at a slight off perpendicular from the keel toward the base of the wing, going just through the superficial pectoral; if the incision is made parallel to those fibers rather than across it, I think we're probably causing somewhat less damage. Fran, how have you been taking yours?

FRAN HAMERSTROM. I go off to the sides on a Harrier, about ¾ inch in and I take it exactly as Dr. Graham suggested, trying to destroy as little muscle as possible. And I avoided any cutting up and down along the line of the keel; I take it along with the muscle and pick out my piece.

FRANK. You don't find that you get excessive bleeding when you take it lower down on the rib cage? The one time we did try it, the bird just about bled to death.

HAMERSTROM. We knew one slight bleeder, but it wasn't bad at all. Ordinarily we get essentially no blood.

FRANK. This is what I find when we took it up higher.

HAMERSTROM. We caught them again sometimes and we found excellent healing. We kept records and we imped colored feathers so that we could follow those individuals to see whether they were feeding their young properly, to see whether they are defending their nest properly. We have a whole crew out there watching to see how things are going. So, I'm really sold on this way of doing it, and getting them back fast; I wouldn't think of holding them, of course.

TOM DUNSTAN. I presented a paper at the Midwestern Wildlife Conference several years ago on this same technique and at that time we had worked with Great Horned Owls, Bald Eagles, Red-tails, and Rough-legs to get an idea of what effect it might have on flight. The technique was similar to yours. I found it better to take it up high; I found no bleeding problem. Another thing, when we worked with Kestrels, sometimes the muscle here isn't very well developed.

GRAHAM. It tends to be rather thin more posteriorly, and you do run the risk, in young birds, of actually incising through the rather thin, still cartilage-nous portion of the sternum. In fact it is practically membranous at that point, actually invading the body cavity. It's minor surgery up to that point; getting into the abdominal cavity, we would have to call it major.

FRANK. The important thing in our work we decided that it might be less damaging. We didn't compare it with the parallel, we never did go parallel to the muscle fibers. We did think it would be less damaging if we took a wider but shallower cut.

FRANK (comment written later). It is true that an incision parallel to the grain will cut fewer fibers and may well be preferable to the method as described. We first used the technique exactly as described by Seidensticker, and since we encountered no difficulties, and the birds were to all appearances unaffected by the operation, we continued to use the anterior-posterior incision along the keel. Histological work on poultry comparing both methods is in progress at Kabete and will provide information on wound healing following both types of incision.

I was surprised to learn from Dr. Hamerstrom that she can remove the biopsy so low on the thorax without encountering severe hemorrhage. As mentioned, when we tried this site on a Lanner Falcon, cutaneous bleeding was heavy and persistent.

Anesthesia and Biopsy Sampling

HAMERSTROM. I've been biopsying Harriers, I suppose 40 or 50. I do not anesthetize them when I'm taking muscle samples. I want to get those birds back on the wing as fast as I can. It takes me less than 10 minutes as a rule, and I can do it alone. I simply hold the bird's legs between my feet and get going, take out the sample and do suture; I let them go, and they go back to raising their young. They go back to stooping violently at Horned Owls which is my technique for trapping them, and I'd be afraid to use an anesthetic. I wouldn't like the extra five or ten minutes that would keep those birds out of the wild. I want to do it fast and get it over with and I certainly haven't had any feeling that I was causing the birds a lot of pain. I interrupt their lives very shortly. I've also done this with Prairie Chickens displaying at booming grounds and had them come right back and hold their territories; that's a good acid test. So, it's

just a wholly different background from where you've been working and how we've been doing things, but my method's been working.

FRANK. I personally find it a bit difficult to chop into a healthy unanesthetized bird.

GRAHAM. I may make a comment here that there are individuals who have been doing fat biopsies without using anesthesia. As a veterinarian it tears the hell out of my sensibilities to do this sort of thing, and I haven't yet, but I do know of people who have been getting away with it rather cleanly.

DUNSTAN. I was wondering if you people feel then that it is necessary to have this anesthetic or not?

FRANK. We used this CT 1341 for personal reasons, we didn't like to operate on an unanesthetized bird and we'd have it back on its feet in half an hour. These birds weren't breeding or on migration.

GRAHAM. I will admit that we have probably all seen birds that have been subject to acute trauma, such as this in fact is, that tend to appear none the less for wear, soon get over it, and get the hell out of there very quickly apparently unimpaired. Whether they are suffering in fact the pain we think they are in or we imagine that we would under the same circumstances I don't know. But I do think that as we have at our disposal an increasing number of anesthetic agents of increasing safety factors such as ketamine which is far better than anything we had up until it came out. There are a few other experimental drugs from Parke-Davis of the same general sort with which the bird is down, under good anesthesia, usually for at least 30 minutes or longer depending on the dose but usually recovering within a matter of hours, and now this preparation of which I was formerly ignorant, and now very interested in. I think that because of the safety of these agents, their speed of action shouldn't militate against their use. I think their use can be recommended, and probably with their use we can reduce shock to some extent, should it be occurring as a result of the trauma of handling and incisional surgery.

FRANK (comments written later). Dr. Hamerstrom was very emphatic about the deleterious effects of anesthetizing the birds prior to surgery, which she said was more disorienting and stressful to the bird than surgery alone. This is a difficult criticism to answer because her situation was different from ours in several respects.

(1) The anesthetic we used, CT 1341, is unique in its speed of action and its very short recovery time, which is so brief and uneventful that the bird is subject to minimal distressing side effects. Moreover, this steroid provides excellent muscle relaxation, facilitating surgery and dispensing with the need for an assis-

tant to restrain the bird.

(2) In many countries, including Great Britain and Kenya, it is necessary to obtain a permit to conduct animal experimentation unless the proposed work is for the therapeutic benefit of the subject. Such a license would be very difficult to get for work involving surgery on unanesthetized animals.

(3) In Dr. Hamerstrom's research, she was biopsying nesting birds and obviously wanted to keep them away from eggs or young for as short a time as possible. In our case, this was not a consideration, as we avoided breeding raptors because we were not dead certain that the biopsy would not interfere in a small way with their hunting ability, and chose to err on the side of safety by feeding the hawks for one to three days rather than releasing them right away.

(4) That the biopsy surgery does cause pain is evident from the reaction of an unanesthetized bird, or one recovering from the anesthetic before suturing is completed. Personal feelings of the investigator aside, it is clear from one of the papers read at the conference that there are people who would like to see all raptor research stopped, and who delight in examples of "cruelty" or mishandling on the part of legitimate researchers. Avoiding this sort of bad publicity alone is sufficient grounds to warrant the use of an anesthetic in any work requiring potentially painful manipulations of an animal, particularly when there is as much public interest and controversy as there has been recently on many phases of raptor research.

Finally, Dr. Hamerstrom's report that her harriers were completely capable of defending the nest and vigorously stooping at intruders soon after surgery is further evidence that the pectoral muscle biopsy is a safe method for obtaining tissue samples and does not hamper a bird's flying abilities. Data of this sort on falcons and accipiters released immediately following surgery would clear any doubts about the technique's over-all applicability in pollution ecology.

Anesthesia in Owls

TOM RICHARDS. Did you use any of these anesthetics on owls?

FRANK. Yes, we did.

RICHARDS. Was there any difference?

FRANK. They are essentially the same.

RICHARDS. They seem to be a little bit slow.

FRANK. We used CP 1341 in Barn Owls and an African Eagle Owl and it took slightly longer perhaps. I put 8 mg into an Eagle Owl and got 11 minutes, and at 6.7 mg got 13 minutes, that's a little longer than any diurnal raptors. And the Barn Owl was about the same, 7.2 mg and down 13½ minutes.

Use of Tranquilizers

CATHY ELLIS. Of those that died not because of their injuries but because of the trauma, I was wondering whether tranquilizers have been used in any of these cases?

GRAHAM. There are some tranquilizers that are coming to be used now, in fact some that have been used in man, for a number of years but have only recently been investigated in birds. One particularly is Valium; the effects are not particularly evident with regard to the bird becoming drowsy or droopy but definitely less responsive to external stimuli. I do think that they have an advantage in the shipment of raptors, particularly the more excitable types and accipiters certainly fit in that class. They have been used in various ways in raptors for a number of purposes and these should be looked at in contrast to some of the more commonly used tranquilizers. Thorazine is a very commonly used one, also Stellazine; these are chlorochromazine type tranquilizers, chromazine derivatives. They tend to have a longer lasting effect or rather an irregular effect that is not predictable.

Rehabilitation Philosophy

JOHN SMITH. I am from Texas Fish and Wildlife. I agree with specific rehabilitation but, except for research, shouldn't we be giving ourselves some standard now on limiting the volume of rehabilitation on common species. I can see in some states this thing really gets out of hand, with 80-90% of the volume real common stuff that is destroyed every day naturally, and 10-20% of the volume is stuff that really needs the attention or support. I would like to hear some opinion on that subject.

BRUCE WOLHUTER. You are trying to say you think there should be a limit on it, for certain species?

SMITH. Yes, I mean some day we really do a good education program, somebody comes across any kind of sick or wounded raptor, they will turn them in and so like our old folks with homes today, we will be extending the older raptors. I'm not talking about rare stuff or endangered species.

WOLHUTER. The point I want to make is that if you are getting birds in that large a volume you had better start doing more work in the education line. With the center that we have here in Colorado, and I'm speaking just for two areas, we haven't had any volumes where it really became that great of a problem with any particular species.

SMITH. It's a brand new thing, but in four or five years who knows?

WOLHUTER. That's why I feel education is really most important. For instance, I'm going to try to get a news release put out in Colorado. We hope that most of the papers will carry it, giving people the idea, reminding them that it's illegal to take birds and in this way providing them with information of which they are not even aware. A lot of these people don't even have access to raptor statutes and the only way they find out about laws is when they are taken into court. I think again education in the news media is going to cut down on a lot of these birds that we shouldn't have to see. It is an alternative to rehabilitation or a preventative perhaps.

THE RAPTOR RESEARCH FOUNDATION, INC. is a non-profit corporation whose purpose is to stimulate, coordinate, direct and conduct research in the biology and management of birds of prey, and to promote a better public understanding and appreciation of the value of these birds.

A major activity is publication. The quarterly *Raptor Research* prints research, reports, reviews, comments and news notes. The quarterly *Raptor Research Abstracts* summarizes and indexes literature on these birds. Longer papers or collections of papers are in *Raptor Research Report.*

Another important activity is the sponsoring of conferences. There have been three Captivity Breeding Conferences. The Conference on Raptor Conservation Techniques in March 1973 provided a very extensive review of current raptor research. The Proceedings will appear in issues of *Raptor Research* and *Raptor Research Report.*

Systems of information exchange on specialized areas have been initiated. Ninety "Breeding Project Information Exchange (BPIE) have appeared so far (available by subscription of $3 sent to BPIE, Laboratory of Ornithology, Cornell University, 159 Sapsucker Woods Road, Ithaca, NY 19850). A new project, "Raptor Telemetry Information Exchange" (RTIE), begins with a research survey report (subscription $1 from RRF). Additional special area information exchanges are anticipated soon.

Another active area has been the Pathology Committee. This group of professional veterinarians and others deals with the special health problems of raptors. They have conducted autopsies, treated ill birds, and provided consultation information as well as providing valuable information at several of our conferences.

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Membership in the Raptor Research Foundation is open to all who contribute. *Raptor Research* is sent to all who contribute a minimum of $6.00 per year; those who wish to receive both *Raptor Research* and *Raptor Research Abstracts* contribute an additional $4.00. Memberships should be sent to: Edward S. Freienmuth, RRF Membership Services, RR 3, Box 301, Durango, Colorado 81301.

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No. 3. Population Status of Raptors (Proc. Rapt. Cons. Tech. Part 6) in press. $6.25 (members $5.00).